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ABSTRACT

Procedures for establishing the cutoff scores for the occupational competency exams administered to individuals graduating from Pennsylvania vocational teacher education programs were reviewed. A total of 595 National Occupational Competency Testing Institute (NOCTI) Exams administered in 43 occupations or trades at three colleges between the years 1979 and 1984 were reviewed. Test scores were compared with respect to exam date, test site, exam code, percentage of correct responses for written and for performance tests, and pass/fail decision for written and performance tests respectively. It was concluded that Pennsylvania could and should use the national norms provided on those exams to make the pass/fail decisions for prospective vocational teachers. Whatever decision is made concerning a cutoff for the performance exam, it should be based on the same rationale and be consistent with the method used for the written exam. The 95 percent confidence interval (two standard errors [SE]) should be used in implementing any cutoff decisions. In those cases where the two SE cutoff does not result in a sufficient supply of vocational teachers, a mechanism should be implemented to permit individuals to teach temporarily while they improve their occupational knowledge until they meet minimum standards. (Appendixes to this report include six tables detailing the test score statistics compiled.) (MN)

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FINAL REPORT

# REVIEW OF THE SCORING PROCEDURES FOR THE OCCUPATIONAL COMPETENCY ASSESSMENT PROGRAM IN PENNSYLVANIA

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VOCATIONAL – TECHNICAL EDUCATION **Research Report**

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# Review of the Scoring Procedures for the Occupational Competency Assessment Program in Pennsylvania

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October, 1985

In support of PDE Occupational Competence Examination

## Introduction

The objectives for this project were twofold:

A. To review the decision made in 1979 to adopt the subtraction of the standard deviation from the mean to establish the cutoff scores for the performance portions of the occupational competency examinations.

B. To recommend either the continuation of the current scoring procedure, or the return to the use of the standard error in the cutoff score calculation.

## Procedure

The sample for the study included all available NOCTI Occupational Comptency Exams from Temple, Penn State and Pitt between the years 1979 and 1984. In all, 595 cases were available representing 43 different occupations or trades. Table 1 provides a summary of the data utilized (See Appendix for Tables 1 - 6). It can be seen from the table that the mean ($\bar{X}$) written exam score during that period was approximately 65% while the mean performance score was approximately 71%. The ranges for the two parts were 30 to 92 and 21 to 100 percent respectively. For the 521 individuals who took the written exam approximately 63% were judged to have passed, while for the 475 who took the performance exam approximately 78% passed. The largest number of cases in the sample were obtained in the Fall of 1979 (20%) and the fewest in the Fall of 1980 (0.2%). When the number of cases in the sample were examined according to site, Penn State and Temple were about equal with 38 and 37 percent respectively, followed by Pitt with 25 percent. The most frequent occupations tests reflected in rank order were: auto mechanics (79), carpentry (75), welding (52), machine trades (29), building trades maintenance (28), and auto body and fender (28).

In order to carry out the data analysis, all 595 cases were entered into one large computer file with variables for data of exam, test site, exam code, percent correct for written, percent correct for performance and pass/fail decision for written and performance respectively. Using the descriptive statistics, frequencies, bargraph and

histogram options with the SPSS program the data were transformed for the purpose of analysis. Tables 2 and 3 report the results of the descriptive analysis showing number of cases, mean ($\bar{X}$), standard deviation (SD), range, percent passed, and number passed for both written and performance exams. Each table also reports the national 1985 norms for all exams including mean, standard deviation and standard error (SE).

In order to gather the kind of information necessary to satisfy the first objective of this study it was decided to construct a frequency distribution of all scores obtained for each trade or occupation written and performance exam. Using this distribution graphed on a laser printer by the computer, it was possible to draw pass/fail lines representing several possible cutoff decisions. Pass/fail cutoffs were graphed for one SD below the $\bar{X}$, one SE below the $\bar{X}$ and two SE below the $\bar{X}$. Information from these graphs was transcribed to table form for the 18 occupational exams for which there were 10 or more cases. Table 4 using percent and 5 using frequencies represent the results of these calculations and compare the three possible cutoff methods to the actual pass/fail decisions that were made. Table 6 reports the difference between using the two SE cutoff methods and the actual pass/fail decisions as they were made.

All of the data analysis described here is contained in an appendix to this report. This appendix is quite large measuring approximately two inches thick and weighing several pounds.

Other reports which are relevant to this study and provide a background for the Occupational Competency Testing Program in Pennsylvania include: Kapes and Funk (1981); Kapes and Funk (1978a) (1978b); Kapes, Funk, Welch, and Yung (1977a and 1977b); and Kapes (1976). The NOCTI competency testing technical reports (McMahan, 1982; Rupe, 1985) should also provide information useful to readers of this report. Complete bibliographic information for these reports appears in the reference list.

## Findings

Table 4 reports various pass/fail percentages for the updated exams with 10 or more cases; Table 5 reports the same data in frequencies. Data is reported for both the written and performance exams including the number of cases (N), the actual percent of that number passing, the percent that would have passed if the cutoff had been one Standard Deviation (SD), the percent that would have passed if the cutoff had been one Standard Error (SE), and the percent that would have passed if the cutoff had been two Standard Errors (2SE). Across the bottom of the table are the median values for each of the above along with range of values reported as the highest and lowest value in the table.

For example, from Table 4 for trade area number 03 (auto mechanics) there were 74 individuals who took the written exam in Pennsylvania between 1979 and 1984 for which data was available. Of those individuals, 46 percent (34 individuals - see table 5) were judged to have passed the test using a cutoff method established with Pennsylvania norms (the Pennsylvania $\bar{X}$ minus one SE was used). If the national $\bar{X}$ for auto mechanics minus the SD were used 76 percent of the 79 cases would have passed. If the national $\bar{X}$ minus one and two SE were used as a cutoff, 30 and 40 percent respectfully would have passed. As can be seen from comparing the actual and one SE columns for the written exam the use of the national norms with one SE would have resulted in fewer passes in most, but not all, cases.

The cutoff for the performance exam in Pennsylvania since 1979 has been the Pennsylvania $\bar{X}$ minus one SD. This more generous cutoff was used for the performance exam because of the fairly subjective nature of the exam. This had the effect of a relatively high pass rate for the performance exam (77.7%) as opposed to the written exam (62.8%). Also, from an examination of the actual data it was found that in relatively few cases did the performance exams have an effect on the combined pass/fail decision. That is, almost all of the individuals who passed the written exam also passed the performance exam.

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Because the previous Pennsylvania approach to setting a cutoff for the written and performance exams lacked uniformity and resulted in the written exam being the primary decision maker, it was decided to try to find a method based on national norms which would be uniform and balance the effect of the written and performance exams. The national $\bar{X}$ minus 2 SE was selected as a possible cutoff which might be satisfactory. Table 6 reports the results of the comparative analysis between actual and 2 SE in frequency of cases for both the written and performance exams.

The data for Table 6 is reproduced from Table 5 with an additional column for the differences between the two methods. As can be seen from the table for the written exam, the differences range from 5 fewer passes for the auto mechanics, printing and brick masonry exams to 7 and 8 more passes for the welding and carpentry exams respectively. The total difference for all written exams using the 2 SE cutoff would have been 9 fewer passes or a minus 2 percent.

For the performance exams, the use of the 2 SE cutoff has a much greater and negative effect. For auto mechanics, 25 fewer cases would have passed and this lesser pass rate, while much smaller in all the other areas, is found in all but 3 of 18 areas reported in the table.

On the average, the pass rate using 2 SE drops 2 percent (from 61 to 59 percent) for the written exams and 19 percent (from 76 to 57 percent) for the performance exam.

## Discussion on Norms

The concept of Norms can be approached in at least in two different ways. In the most common approach, a fairly large set of scores obtained on some measure completed by the norm group are simply described in terms of some second variable. This second variable may be age or grade or percentile. In this approach, the norm user decides what point a score is to be compared with and draws appropriate conclusions. For example, the user may want to compare a score to that obtained by 10 year olds, or 5th graders, or with the 70 percentile for all those who took the test.

A second approach to Norms (more pertinent to occupational competency exams) occurs when only two classes of description for a set of scores are desired -- Pass and Fail. With this approach, the user simply locates a score and after considering measurement error, finds it to fall above or below a given cutoff. In this example, good or bad, high or low is determined by the norm group. In the second case (often referred to as criterion referenced measurement) the quality of a score is determined by a value judgement.

The setting of norms or cutoffs for occupational competency exams is a problem which lies somewhere between the two examples provided above. That is, while a particular cutoff must be set, and the point selected is a matter of judgement, the information provided by comparing the scores to the performance of a norm group can be very useful in determining measurement error and selecting a cutoff score.

The most desirable method of setting a cutoff score is to compute the relationship between the test scores and subsequent desirable behavior. Ideally, if the relationship is perfect, all those who score above a certain point can perform the behavior (e.g. vocational teaching) and all those falling below cannot. In this case, neither our exams nor our concept of what is desirable behavior are good enough to allow us the luxury of the ideal case. However, since a decision must be made, we cannot simply throw up our hands.

Three possible methods of setting cutoffs are discussed here which might provide a solution. The first and most traditional is to just pick a percentage right and consider that passing. In the past, this was done with 70% considered passing. The problem with this approach is that it does not consider the difficulty of the exam. As can be seen from looking, at mean percent correct for each occupational exam in Table 2 and 3, test difficulty has a wide range. For many exams hardly anyone would pass using a 70% cutoff, while for some other exams almost everyone would pass. Even if we choose a point at 60% or 70%, there is no good rationale available to defend our decision.

A second possible approach to setting a cutoff score is to use the arithmetic average or mean. In this manner, whether the exam was easy or difficult, only examinees who are average or above average would be permitted to pass. When the norm group is large enough this solution is quite viable; however, with small samples the mean is affected greatly by a single low score. Because it is possible to obtain a low score, but not a high score, by any number of errors, most of the competency exam score distributions in this study are negatively skewed (that is, the mean has been pulled down by one or two low scores, without any corresponding high scores to offset this effect.) When the samples are very small (>10) this effect is great resulting in 60 - 70% of the scores being above the mean.

A third approach which could be applied to the problem is to use the media (or middle score) rather than the mean in setting a cutoff. In this manner, 50% of the scores will always be judged passing without any effect from very low scores. This approach could be carried further and instead of the median being selected (50th percentile) any other percentile could be chosen.

Whichever approach is selected, some allowance should be made for measurement error. Since our exams are not perfectly reliable, an individual's true score may vary somewhat from his or her obtained score. The most common approach

to dealing with measurement error is to apply the Standard Error of Measurement (SE) which is a function of both the test variability (Standard Deviation) and the reliability. The formula for computing SE is as follows:

$$SE = SE\sqrt{1 - rxx}$$

where: SE = standard error of measurement

SD = standard deviation

rxx = reliability coefficient

(for example) if: SD = 16

rxx = .90

then: $SE = 16\sqrt{1 - .90}$

$= 16 * \sqrt{.10}$

$= 16 * .32$

The standard error, is the range plus or minus where an obtained score will fall 68% of the time. From examining the results of previous studies it can be seen that where competency exams have approximately 200 items, an average difficulty of 60 - 70%, and a reliability of .90, the SE will usually range between 5 and 6 raw score units. The use of two SE's produces a confidence interval of 95% and will usually range from 10 to 12 raw score units.

## Conclusions and Recommendations

From all of the data analyzed and presented in the appendix and in Tables 1 to 6 it appears that Pennsylvania, as one of the biggest users of the NOCTI Occupational Competency Exams, could and should use the national norms provided on those exams to make the pass/fail decisions for perspective vocational teachers. Furthermore, whatever decision is made concerning the setting of a cutoff for the performance exam it should be based on the same rationale and be consistent with the method used for the written exam. Based on these assumptions, the following recommendations are offered:

1. The arithmetic mean ($\bar{X}$) computed for the national sample of individuals taking each occupational competency exam should be the theoretical cutoff used to select candidates for teachers of vocational subjects in Pennsylvania.
2. Both written and performance competency exams should use the same cutoff method for making pass/fail decisions.
3. Due to the inherent error involved in testing, the 95% confidence interval (2 SE) should be used in implementing any cutoff decisions using occupational competency exams.
4. In those cases when the use of 2 SE cutoff does not result in a sufficient supply of vocational teachers, a mechanism is necessary to temporarily permit individuals to teach while they are given the opportunity to improve their occupational knowledge until they meet minimum standards.

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# APPENDIX

Table 1

Descriptive Statistics

| Variable | Data | | |
|---|---|---|---|
| Date | Range = Spring 1979 to Fall 1984 | | |
| Site | 1 = Temple, 2 = PSU, 3 = Pitt | | |
| Trade | 02 to 73, 595 cases, 5 missing both scores, 43 trades | | |
| Written | $\bar{X}$ = 64.9%, SD = 10.3% Range = 30.6% - 92% | | |
| Performance | $\bar{X}$ = 71.41%, SD = 16.9% Range = 21% - 99.9% | | |
| Pass/Fail | | Written | Performance |
| | Pass = | 62.8% | 77.7% |
| | Fail = | 37.2% | 22.3% |
| | N = | 521 | 475 |
| *Date Frequency | Fall 1979 | 120 cases = 20% | See page 6 of computer printouts for entire listing (Appendix) |
| Most Cases | Spring 1980 | 108 cases = 18% | |
| | Summer 1981 | 79 cases = 12.3% | |
| Least Cases | Summer 1979 | 13 cases = 2.2% | |
| | Fall 1980 | 1 case = .2% | |
| *Site Frequency | Temple | 221 cases = 36.8% | |
| | PSU | 227 cases = 37.8% | |
| | Pitt | 152 cases = 25.3% | |

*Note: No data for 1982 and only PSU data for 1983 and 1984

| Trade Frequency | Most | Cases | % | Least (1 each = .2%) |
|---|---|---|---|---|
| | 03 Auto Mechanics | 79 | = 13.2% | 05 Small Engine |
| | 07 Carpentry | 75 | = 12.5% | 09 Masonry |
| | 57 Welding | 52 | = 8.7% | 39 Upholstery |
| | 20 Machine Trades | 29 | = 4.8% | 49 Audio Visual |
| | 25 Building Trades Maint. | 28 | = 4.7% | 63 Tailoring |
| | 50 Auto Body & Fender | 28 | = 4.7% | 67 Custodial |
| | | | | 69 Heavy Equip. |

Table 2

Statistics by Trade - Written

| No. | Trade Name | N | Pennsylvania Data (%) $\bar{X}$ | SD | Range | Pass | (N) | National Norms 85 $\bar{X}$ | SD | SE |
|---|---|---|---|---|---|---|---|---|---|---|
| 02 | Auto Body | 1 | 30.6 | ---- | ----- | 0 | 0 | 68.3 | 7.2 | .7 |
| 03 | Auto Mechanics | 74 | 61.3 | 8.5 | 38-80 | 46 | 34 | 66.1 | 11.0 | .5 |
| 05 | Small Engine | 1 | 83.0 | ---- | ----- | 100 | 1 | 70.1 | 8.7 | 1.0 |
| 06 | Air Cond. & Repair | 9 | 67.0 | 6.7 | 57-76 | 67 | 6 | 64.1 | 9.7 | 1.1 |
| 07 | Carpentry | 62 | 73.5 | 7.5 | 55-90 | 64 | 40 | 70.0 | 9.9 | .5 |
| 08 | Electrical Occupations | 15 | 55.0 | 9.4 | 41-70 | 53 | 8 | 64.2 | 13.4 | 1.7 |
| 09 | Masonry | 1 | 57.5 | ---- | ----- | 100 | 1 | 68.6 | 12.4 | 1.3 |
| 10 | Plumbing | 21 | 56.3 | 7.1 | 44-70 | 43 | 9 | 56.2 | 6.1 | .6 |
| 11 | Sheet Metal | 6 | 68.2 | 6.8 | 60-80 | 67 | 4 | 67.7 | 8.6 | 1.1 |
| 12 | Architectural Drafting | 2 | 67.3 | 4.7 | 64-71 | 50 | 1 | 65.2 | 7.4 | .9 |
| 13 | Mechanical Drafting | 10 | 69.2 | 7.8 | 54-81 | 50 | 5 | 66.7 | 11.3 | 1.1 |
| 14 | Industrial Electricity | 13 | 70.8 | 7.3 | 60-80 | 69 | 9 | 65.7 | 11.4 | 1.2 |
| 19 | Printing | 14 | 55.4 | 7.4 | 44-68 | 50 | 7 | 65.9 | 15.0 | 1.4 |
| 20 | Machine Trades | 26 | 59.8 | 8.1 | 45-74 | 54 | 14 | 63.7 | 11.2 | .8 |
| 23 | Mechanical Technology | 2 | 63.4 | 12.5 | 55-72 | 50 | 1 | 46.7 | 7.2 | 3.6 |
| 24 | Cabinet Making/Mill | 13 | 65.0 | 9.1 | 52-80 | 77 | 10 | 61.1 | 10.6 | 1.1 |
| 25 | Building Trades Maint. | 24 | 63.0 | 9.5 | 41-75 | 75 | 18 | 62.6 | 9.5 | 1.1 |
| 26 | Computers | 18 | 67.0 | 14.7 | 42-91 | 44 | 8 | 68.2 | 13.6 | 1.4 |
| 27 | Major Appliances | 7 | 60.7 | 2.9 | 56-64 | 100 | 7 | 58.9 | 5.6 | .9 |
| 29 | Commercial Arts | 8 | 61.0 | 9.2 | 48-76 | 62 | 5 | 60.4 | 8.5 | 1.3 |
| 33 | Materials Handling | 10 | 74.7 | 14.1 | 38-88 | 90 | 9 | 77.7 | 10.9 | 2.2 |
| 35 | Painting & Decorating | 2 | 66.8 | 3.7 | 64-70 | 100 | 2 | 58.4 | 11.4 | 2.7 |
| 36 | Power Sewing | 6 | 60.9 | 5.7 | 52-68 | 67 | 4 | 64.9 | 6.4 | 1.7 |

Table 2 (continued)

Statistics by Trade - Written

| No. | Trade Name | N | Pennsylvania Data (%) $\bar{X}$ | SD | Range | Pass | (N) | National Norms 85 $\bar{X}$ | SD | SE |
|---|---|---|---|---|---|---|---|---|---|---|
| 37 | Graphic Arts | 1 | 65.8 | ---- | ----- | 100 | 1 | 53.9 | ---- | --- |
| 38 | Textile Prod./Fabric. | 4 | 65.5 | 10.8 | 54-76 | 100 | 4 | 65.7 | 10.0 | 3.5 |
| 42 | Building Construction | 10 | 68.8 | 7.3 | 56-76 | 90 | 9 | 64.7 | 8.9 | 1.3 |
| 44 | Heating | 3 | 69.6 | 3.4 | 63-70 | 100 | 3 | 63.4 | 5.8 | 1.3 |
| 46 | Metal Fabrication | 4 | 47.3 | 3.9 | 44-53 | 0 | 0 | 69.1 | ---- | --- |
| 48 | Radio/TV | 3 | 77.5 | 12.6 | 70-92 | 100 | 3 | 69.0 | 10.5 | 3.0 |
| 49 | Audio Visual | 1 | 67.7 | ---- | ----- | 100 | 1 | 67.2 | 5.9 | 2.9 |
| 50 | Auto Body & Fender | 23 | 62.6 | 7.4 | 51-79 | 61 | 14 | 61.3 | 5.9 | .6 |
| 51 | Brick Masonry | 11 | 76.1 | 5.5 | 69-85 | 100 | 11 | 75.7 | 6.4 | 1.0 |
| 52 | Diesel Mechanics | 8 | 56.6 | 12.6 | 33-71 | 67 | 6 | 60.8 | 9.9 | 1.8 |
| 53 | Electronics Technology | 16 | 64.6 | 10.0 | 49-82 | 56 | 9 | 62.0 | 11.5 | 1.1 |
| 54 | Masonry Occupations | 4 | 67.5 | .7 | 67-68 | 100 | 4 | 64.5 | 5.5 | 2.0 |
| 55 | Quantity Foods | 18 | 72.1 | 4.4 | 65-81 | 100 | 18 | 70.7 | 7.5 | .9 |
| 56 | Small Engine Repair | 6 | 67.4 | 12.2 | 59-91 | 16 | 1 | 67.2 | 9.4 | 1.8 |
| 57 | Welding | 47 | 67.6 | 8.0 | 43-87 | 57 | 27 | 64.9 | 9.3 | .9 |
| 59 | Baking | 1 | 61.7 | ---- | ----- | 100 | 1 | 59.3 | 4.4 | 1.2 |
| 60 | Drafting Occupations | 5 | 54.0 | 11.2 | 47-74 | 100 | 5 | 53.2 | 11.8 | 1.6 |
| 61 | Electrical Construction | 8 | 58.7 | 7.4 | 49-69 | 62 | 5 | 76.9 | ---- | --- |
| 70 | Comm. Photography | 2 | 52.6 | 3.7 | 50-55 | 50 | 1 | 52.7 | ---- | --- |

Table 3

Statistics by Trade - Performance

| No. | Trade Name | N | Pennsylvania Data (%) $\bar{X}$ | SD | Range | Pass | (N) | National Norms 85 $\bar{X}$ | SD | SE |
|---|---|---|---|---|---|---|---|---|---|---|
| 03 | Auto Mechanics | 65 | 70.4 | 15.0 | 41-96 | 78 | 51 | 75.0 | 16.8 | .9 |
| 05 | Small Engine | 1 | 91.1 | ---- | ----- | 100 | 1 | 82.4 | 17.3 | 2.1 |
| 06 | Air Cond. & Repair | 9 | 76.9 | 13.2 | 51-96 | 88 | 8 | 81.5 | 11.2 | 1.4 |
| 07 | Carpentry | 61 | 70.5 | 20.2 | 25-99 | 84 | 51 | 68.0 | 20.1 | 1.1 |
| 08 | Electrical Occupations | 14 | 76.9 | 12.8 | 54-95 | 100 | 14 | 75.2 | 19.1 | 2.5 |
| 10 | Plumbing | 14 | 77.1 | 9.7 | 55-95 | 93 | 13 | 76.4 | 16.9 | 1.9 |
| 11 | Sheet Metal | 5 | 96.2 | 5.0 | 90-99 | 100 | 5 | 80.1 | 21.5 | 3.3 |
| 12 | Architectural Drafting | 2 | 68.3 | 39.5 | 40-91 | 50 | 1 | 74.4 | 16.7 | 2.0 |
| 13 | Mechanical Drafting | 7 | 73.5 | 12.9 | 48-88 | 86 | 6 | 78.2 | 15.4 | 1.6 |
| 14 | Industrial Electricity | 13 | 70.7 | 15.2 | 38-96 | 62 | 8 | 76.0 | 16.7 | 1.8 |
| 19 | Printing | 17 | 70.2 | 10.4 | 54-87 | 76 | 13 | 74.8 | 15.5 | 1.3 |
| 20 | Machine Trades | 26 | 65.0 | 15.0 | 28-86 | 85 | 22 | 72.8 | 20.1 | 1.6 |
| 23 | Mechanical Technology | 1 | 77.9 | ---- | ----- | 100 | 1 | 69.6 | 22.7 | 16.0 |
| 24 | Cabinet Making/Mill | 12 | 78.6 | 17.9 | 40-94 | 83 | 10 | 77.5 | 16.7 | 1.8 |
| 25 | Building Trades Maint. | 25 | 66.8 | 11.7 | 46-85 | 56 | 14 | 67.9 | 11.0 | 1.3 |
| 26 | Computer | 17 | 79.0 | 13.2 | 54-98 | 76 | 13 | 65.9 | 26.3 | 2.8 |
| 27 | Major Appliance Repair | 8 | 65.9 | 19.5 | 44-94 | 62 | 5 | 80.3 | 15.3 | 2.4 |
| 29 | Commercial Arts | 2 | 82.7 | 7.6 | 77-88 | 100 | 2 | 67.5 | 19.5 | 3.3 |
| 33 | Materials Handling | 9 | 74.4 | 6.8 | 61-84 | 55 | 5 | 77.8 | 11.8 | 2.3 |
| 35 | Painting & Decorating | 2 | 73.5 | 13.4 | 64-83 | 50 | 1 | 70.8 | 10.0 | 2.5 |
| 36 | Power Sewing | 5 | 80.0 | 4.8 | 74-86 | 40 | 2 | 75.8 | 13.8 | 3.8 |
| 37 | Graphic Arts | 2 | 83.2 | 9.9 | 76-90 | 100 | 2 | 73.7 | ---- | ---- |

Table 3 (continued)

Statistics by Trade - Performance

| No. | Trade Name | N | Pennsylvania Data (%) $\bar{X}$ | SD | Range | Pass | (N) | National Norms 85 $\bar{X}$ | SD | SE |
|---|---|---|---|---|---|---|---|---|---|---|
| 38 | Textile Prod./Fabric. | 5 | 72.7 | 16.0 | 59-96 | 60 | 3 | 54.5 | 14.7 | 5.5 |
| 39 | Upholstery | 1 | 90.3 | ---- | ----- | 100 | 1 | 90.3 | ---- | ---- |
| 42 | Building Construction | 9 | 77.6 | 17.0 | 51-97 | 67 | 6 | 66.8 | 15.6 | 2.3 |
| 44 | Heating | 3 | 79.2 | 13.5 | 70-95 | 67 | 2 | 75.2 | 11.1 | 2.5 |
| 46 | Metal Fabrication | 3 | 65.1 | 19.7 | 42-78 | 33 | 1 | 69.1 | ---- | ---- |
| 48 | Radio/TV | 4 | 63.9 | 22.4 | 43-93 | 50 | 2 | 78.3 | 18.3 | 5.0 |
| 49 | Audio Visual | 1 | 68.4 | ---- | ----- | 0 | 0 | 77.5 | 16.1 | 9.2 |
| 50 | Auto Body & Fender | 26 | 62.3 | 19.1 | 24-97 | 85 | 22 | 58.3 | 14.9 | 1.7 |
| 51 | Brick Masonry | 10 | 84.4 | 17.0 | 57-98 | 80 | 8 | 80.5 | 14.1 | 2.3 |
| 52 | Diesel Mechanics | 3 | 85.9 | 17.2 | 67-99 | 100 | 3 | 75.2 | 17.0 | 3.5 |
| 53 | Electronic Technology | 14 | 73.0 | 14.6 | 35-90 | 78 | 11 | 75.2 | 18.1 | 1.9 |
| 54 | Masonry Occupations | 1 | 90.3 | ---- | ----- | 100 | 1 | 81.0 | 6.6 | 2.6 |
| 55 | Quantity Foods | 18 | 77.6 | 13.0 | 52-97 | 83 | 15 | 80.0 | 9.3 | 1.2 |
| 56 | Small Engine Repair | 4 | 81.2 | 8.6 | 76-94 | 25 | 1 | 81.7 | 17.7 | 3.9 |
| 57 | Welding | 47 | 56.8 | 21.2 | 21-96 | 53 | 25 | 57.8 | 19.9 | 2.1 |
| 59 | Baking | 9 | 75.8 | 10.3 | 62-90 | 100 | 9 | 77.5 | 13.6 | 3.2 |
| 60 | Drafting Occupations | 4 | 74.9 | 11.3 | 66-88 | 50 | 2 | 76.3 | 17.4 | 2.5 |
| 61 | Electrical Construction | 5 | 74.6 | 9.8 | 67-91 | 100 | 5 | 76.9 | ---- | ---- |
| 63 | Tailoring | 1 | 94.4 | ---- | ----- | 100 | 1 | 69.5 | ---- | ---- |
| 67 | Custodial | 1 | 92.2 | ---- | ----- | 100 | 1 | 92.2 | ---- | ---- |
| 69 | Heavy Equipment | 1 | 93.7 | ---- | ----- | 100 | 1 | 54.1 | ---- | ---- |

Table 4

Comparison Between Standard Deviation (SD) and Standard Error (SE) Pass/Fail Cut-Off in Percent (N≥10), 85 Norms

| No. | | Written % Pass | | | | | Performance % Pass | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Actual | SD | SE | 2SE | N | Actual | SD | SE | 2SE |
| 03 | Auto Mechanics | 74 | 46 | 76 | 30 | 40 | 65 | 78 | 78 | 40 | 43 |
| 07 | Carpentry | 62 | 64 | 94 | 74 | 77 | 61 | 84 | 85 | 59 | 66 |
| 08 | Electrical Occupations | 15 | 53 | 73 | 27 | 27 | 14 | 100 | 86 | 71 | 79 |
| 10 | Plumbing | 21 | 43 | 90 | 43 | 43 | 14 | 93 | 93 | 57 | 86 |
| 13 | Mechanical Drafting | 10 | 50 | 90 | 70 | 90 | 7 | 86 | 86 | 43 | 43 |
| 14 | Industrial Electricity | 13 | 69 | 100 | 62 | 69 | 13 | 62 | 69 | 96 | 46 |
| 19 | Printing | 14 | 50 | 78 | 14 | 14 | 17 | 76 | 82 | 41 | 53 |
| 20 | Machine Trades | 26 | 54 | 84 | 42 | 42 | 26 | 85 | 77 | 38 | 46 |
| 24 | Cabinet Making/Mill | 13 | 77 | 100 | 69 | 69 | 12 | 83 | 83 | 66 | 66 |
| 25 | Building Trades Maint. | 24 | 75 | 83 | 71 | 71 | 25 | 56 | 68 | 48 | 48 |
| 26 | Computers | 18 | 44 | 79 | 39 | 50 | 17 | 76 | 100 | 88 | 88 |
| 33 | Materials Handling | 10 | 90 | 80 | 80 | 80 | 9 | 55 | 89 | 56 | 78 |
| 42 | Building Construction | 10 | 90 | 90 | 80 | 80 | 9 | 67 | 89 | 78 | 78 |
| 50 | Auto Body & Fender | 23 | 61 | 87 | 52 | 56 | 26 | 85 | 88 | 62 | 65 |
| 51 | Brick Masonry | 11 | 100 | 82 | 54 | 54 | 10 | 80 | 80 | 70 | 70 |
| 53 | Electronic Technology | 16 | 56 | 88 | 68 | 68 | 14 | 78 | 86 | 50 | 64 |
| 55 | Quantity Foods | 18 | 100 | 100 | 67 | 78 | 18 | 83 | 72 | 44 | 50 |
| 57 | Welding | 47 | 57 | 96 | 68 | 72 | 47 | 53 | 60 | 36 | 38 |
| | Medians | 17 | 59 | 89.5 | 64.5 | 68.5 | 15.5 | 79 | 84 | 56.5 | 64.5 |
| | High | 74 | 100 | 100 | 80 | 90 | 65 | 100 | 100 | 88 | 88 |
| | Low | 10 | 43 | 73 | 14 | 14 | 7 | 53 | 60 | 36 | 38 |

Table 5

Comparison Between SD and SE Pass/Fail Cut-Off in Frequencies ($N \geq 10$), 85 Norms

| | | Written # Pass | | | | | Performance # Pass | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Trade Name | N | Actual | SD | SE | 2SE | N | Actual | SD | SE | 2SE |
| 03 | Auto Mechanics | 74 | 34 | 56 | 22 | 29 | 65 | 51 | 51 | 26 | 28 |
| 07 | Carpentry | 62 | 40 | 58 | 46 | 48 | 61 | 51 | 52 | 36 | 40 |
| 08 | Electrical Occupations | 15 | 8 | 11 | 4 | 4 | 14 | 14 | 12 | 10 | 11 |
| 10 | Plumbing | 21 | 9 | 19 | 9 | 9 | 14 | 13 | 13 | 8 | 12 |
| 13 | Mechanical Drafting | 10 | 5 | 9 | 7 | 9 | 7 | 6 | 6 | 3 | 3 |
| 14 | Industrial Electricity | 13 | 9 | 13 | 8 | 9 | 13 | 8 | 9 | 6 | 6 |
| 19 | Printing | 14 | 7 | 11 | 2 | 2 | 17 | 13 | 14 | 7 | 9 |
| 20 | Machine Trades | 26 | 14 | 22 | 11 | 11 | 26 | 22 | 20 | 10 | 12 |
| 24 | Cabinet Making/Mill | 13 | 10 | 13 | 9 | 9 | 12 | 10 | 10 | 8 | 8 |
| 25 | Buidling Trades Maint. | 24 | 18 | 20 | 17 | 17 | 25 | 14 | 19 | 12 | 12 |
| 26 | Computers | 18 | 8 | 14 | 7 | 9 | 17 | 13 | 17 | 15 | 15 |
| 33 | Materials Handling | 10 | 9 | 8 | 8 | 8 | 9 | 5 | 8 | 5 | 7 |
| 42 | Building Construction | 10 | 9 | 9 | 8 | 8 | 9 | 6 | 8 | 7 | 7 |
| 50 | Auto Body & Fender | 23 | 14 | 20 | 12 | 13 | 26 | 22 | 23 | 16 | 17 |
| 51 | Brick Masonry | 11 | 11 | 9 | 6 | 6 | 10 | 8 | 8 | 7 | 7 |
| 53 | Electronics Technology | 16 | 9 | 14 | 11 | 11 | 14 | 11 | 12 | 7 | 9 |
| 55 | Quantity Foods | 18 | 18 | 18 | 12 | 14 | 18 | 15 | 13 | 8 | 9 |
| 57 | Welding | 47 | 27 | 45 | 32 | 34 | 47 | 25 | 28 | 17 | 18 |

Table 6

Comparison Between Actual and Two SE Pass/Fail Cut-Off in Frequencies ($N \geq 10$) 85 Norms

| No. | Trade Name | Written # Pass N | Written # Pass Actual | Written # Pass 2SE | Written # Pass Diff. | Performance # Pass N | Performance # Pass Actual | Performance # Pass 2SE | Performance # Pass Diff. |
|---|---|---|---|---|---|---|---|---|---|
| 03 | Auto Mechanics | 74 | 34 | 29 | -5 | 65 | 51 | 28 | -23 |
| 07 | Carpentry | 62 | 40 | 48 | +8 | 61 | 51 | 40 | -11 |
| 08 | Electrical Occupations | 15 | 8 | 4 | -4 | 14 | 14 | 11 | -3 |
| 10 | Plumbing | 21 | 9 | 9 | 0 | 14 | 13 | 12 | -1 |
| 13 | Mechanical Drafting | 10 | 5 | 9 | +4 | 7 | 6 | 3 | -3 |
| 14 | Industrial Electricity | 13 | 9 | 9 | 0 | 13 | 8 | 6 | -2 |
| 19 | Painting | 14 | 7 | 2 | -5 | 17 | 13 | 9 | -4 |
| 20 | Machine Trades | 26 | 14 | 11 | -3 | 26 | 22 | 12 | -10 |
| 24 | Cabinet Making/Mill | 13 | 10 | 9 | -1 | 12 | 10 | 8 | -2 |
| 25 | Building Trades Maint. | 24 | 18 | 17 | -1 | 25 | 14 | 12 | -2 |
| 26 | Computers | 18 | 8 | 9 | +1 | 17 | 13 | 15 | +2 |
| 33 | Materials Handling | 10 | 9 | 8 | -1 | 9 | 5 | 7 | +2 |
| 42 | Building Construction | 10 | 9 | 8 | -1 | 9 | 6 | 7 | +1 |
| 50 | Auto Body & Fender | 23 | 14 | 13 | -1 | 26 | 22 | 17 | -5 |
| 51 | Brick Masonry | 11 | 11 | 6 | -5 | 10 | 8 | 7 | -1 |
| 53 | Electronic Technology | 16 | 9 | 11 | +2 | 14 | 11 | 9 | -2 |
| 55 | Quantity Foods | 18 | 18 | 14 | -4 | 18 | 15 | 9 | -6 |
| 57 | Welding | 47 | 27 | 34 | +7 | 47 | 25 | 18 | -7 |
| | Total # | 425 | 259 | 250 | -9 | 404 | 307 | 230 | -77 |
| | Total % | 100 | 61 | 59 | -2 | 100 | 76 | 57 | -19 |